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Kinetics and thermodynamic studies on direct saponification of wet biomass of *Chlorella vulgaris* in a low cost microwave reactor: an optimization study

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Conventional methods of biodiesel production from microalgae involve different processes, including microalgae cultivation, harvesting, biomass drying, oil extraction and biodiesel production. Among these, cost-effective oil extraction and biodiesel conversion processes are critical for the industrial-scale production of microalgal biodiesel. Also, drying microalgae after harvesting requires high energy, which accounts for 20-30% of the total cost of biodiesel production. One of the alternatives to overcome these limitations is the 'in situ' transesterification method, in which the lipids in wet algae are simultaneously extracted and converted to Fatty acid Methyl esters (FAMEs). Since the in situ approach integrates the extraction and conversion in one step, it eliminates the need to drying of algae biomass, isolation and refining of lipid before converting it into biodiesel, which could lead to a reduction in cost. However, this technique suffers from disadvantages such as high requirement of methanol and sulphuric acid which must be reduced to avoid the requirement of large reactor and its corrosion by sulphuric acid. In the present work, a low cost lab scale kitchen modified microwave reactor with essential controls (Temperature, time, microwave power and stirring capacity) was used to conduct direct saponification of wet biomass of *Chlorella vulgaris*. The soaps were precipitated using 'common ion effect' and acidulated to fatty acids. Esterification of fatty acids resulted in biodiesel formation. Yield and purity of biodiesel obtained in our work (98.51% and 96.27%) were higher than the values reported in literature. The fatty acid profile of biodiesel indicated the presence of: C14:0,C16:0, C18:0,C24:0, C18:1, C22:1, C18:2, C18:3 and C20:4 ω6. The most abundant FAME is the oleic acid methyl ester, with a content of 41.10 %. Oxidation stability index (OSI) of final biodiesel was 3.0513 h, which indicated its suitability to be a substitute for petroleum diesel.

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